# V08TC065S1X11
# 650V GaN Power Switch
# Preliminary Datasheet

## Description

The D$^3$GaN (**D**irect **D**rive **D**-Mode) V08TC065S1X11 Power Switch integrates a patented, high-density, lateral GaN power transistor, into a **Normally - Off** product with low $R_{DS(ON)}$ and exceptionally efficient switching performance.

An **Isolated High Power** SMD package enables applications requiring High Power and Efficiency, with Low Volume and Cost.

The integrated safety function ensure safe operation during system start up and shutdown, while having no impact on the switching performance of the GaN transistor.

## Key features

- Ultra-fast switching
- Kelvin connection
- Normally-Off
- Ultra low $R_{DS(on)}$ of 8mΩ
- Fully isolated package (3.5KV)
- High Threshold Voltage >5V
- Driven by standard 15V driver
- Top cooling package

## Applications

- Automotive
- AC motors
- Solar Inverter
- AC-DC Power Supply
- Battery chargers
- Laser driver

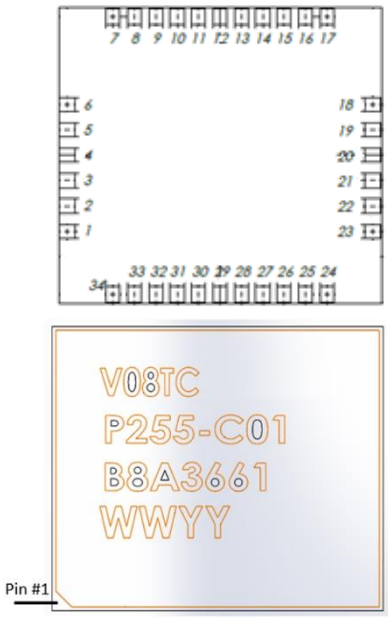


Fig. 1: Die Pinout

## Key Performance Parameters

| Parameter | Value | Units |
|---|---|---|
| $V_{DS}$ | 650 | V |
| $R_{DS(ON)}$ | 8 | mΩ |
| $Q_G$ | 110 | nC |
| $I_{D,pulse}$ | 380 | A |
| $I_D$ | 200 | A |

| Pin | Function |
|---|---|
| 24-34 | Source |
| 1, 22 | Activation signal |
| 3, 21 | Com signal |
| 4, 20 | Gate |
| 2, 23 | Com power |
| 7-17 | Drain |
| 5, 6, 18, 19 | NC* |

*Do not connect to any signal

## Ordering Information:

| Part Number | Packing | Marking | Ordering Number |
|---|---|---|---|
| V08TC065S1X11 | Tray | V08TC065S1X11 | V08TC065S1X11T |


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| Maximum ratings (Tc =25°C unless otherwise specified) | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Max** | **Unit** | **Conditions** |
| Drain-Source breakdown voltage | $V_{(BR)DS}$ | 650 | - | - | |
| Drain Source Transient voltage | $V_{DS(transient)}$ | | 800 | V | Pulse ≤1us |
| Continuous Drain current [1] | $I_D$ | - | 200 | A | |
| | | | 170 | | $T_C$ =100°C[1] |
| Pulsed Drain current[2] | $I_{D,pulse}$ | - | 450 | A | |
| Gate Source voltage | $V_{GS}$ | -20 | 0 | V | Pin4, 20 to pin2, 23 |
| Transient Gate Source voltage | $V_{GS(transient)}$ | -25 | 6 | V | Pulse ≤1us |
| Power dissipation | $P_{TOT}$ | - | 500 | W | |
| Operating and storage temperature | $T_j$ ,$T_{stg}$ | -55 | +150 | °C | |
| | | | | | |
| Continuous reverse current | $I_s$ | - | 200 | A | $T_C$ =25°C[1] |
| | | | | | |
| Reverse pulse current[1] | $I_{s,pulse}$ | - | 380 | A | |
| Gate leakage | $I_{gss}$ | - | 200 | uA | $V_{DS}$= 650V, $V_{GS}$= -15V |
| **Thermal Characteristics** | | | | | |
| Thermal resistance, junction-case | $R_{\theta JC}$ | - | 0.1 | °C/W | |
| Thermal resistance, junction - ambient | $R_{\theta JA}$ | - | 65 | °C/W | |
| Soldering peak body temperature | $T_p$ | - | 260 | °C | |
| Time within 5°C from peak soldering temperature | $t_c$ | - | 30 | S | |

**1)** Limited by Tj max of 150°C, Vgs = 0V, considering Rth(JC) in a discrete package = 0.1°C/W
**2)** Duty cycle =10% and pulse width limited by Tjmax.

| Electrical characteristics ($T_J$ =25°C, $V_{GS}$ = -15V unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typical** | **Max** | **Unit** | **Conditions** |
| **Static** | | | | | | |
| Gate threshold voltage[1] | Vth | 5 | 5.5 | 6 | V | $I_D$=47mA, $V_{DS}$=10V |
| Recommended driving voltage[2] | $V_{DD}$ | | 15 | | V | Refer to driver GND |
| Drain Source leakage current | $I_{DSS}$ | - | 30 | 60 | µA | $V_{DS}$= 650V |
| | | - | 75 | 200 | | $V_{DS}$= 650V $T_J$=150°C |
| Gate resistance | $R_G$ | - | 0.5 | - | Ω | f=1Mhz |
| Drain-Source on state resistance | $R_{DS(ON)}$ | - | 8 | 12 | mΩ | $V_{GS}$=0V $I_D$=35A |
| | | - | 17.5 | - | | $V_{GS}$=0V $I_D$=35A $T_j$ =150°C |
| Reverse voltage drop- GaN non conductive | $V_R$ | - | - | 7.5 | V | $I_D$=10A |
| | | - | - | 9.5 | | $I_D$=10A $T_j$ =150°C |
| Reverse voltage drop- GaN conductive | $V_R$ | - | - | 0.08 | V | $I_D$=10A, $V_{GS}$=0V |
| | | - | - | 0.16 | | $I_D$=10A, $T_j$ =150°C $V_{GS}$=0V |
| Reverse recovery time | $t_{rr}$ | - | - | 0 | ns | |
| Reverse recovery charge | $Q_{rr}$ | - | - | 0 | nC | |
| Output Charge | $Q_{oss}$ | - | - | 420 | nC | $V_{DS}$=400V |
| **Dynamic** | | | | | | |
| Input capacitance | $C_{iss}$ | - | 2000 | 2200 | pF | f=1MHz $V_{DS}$=400V |
| Output capacitance | $C_{oss}$ | - | 500 | 600 | | |
| Reverse transfer capacitance | $C_{rss}$ | - | 70 | 100 | | |
| Effective Output Capacitance, Energy Related | $C_{O(ER)}$ | - | - | 1100 | pF | $V_{DS}$= 0-400V |
| Turn-on delay time | $t_{d(on)}$ | - | 13.5 | - | ns | $V_{DS}$=400V, $V_{DD}$=15V[1] $I_D$=35A, BJT Gate Buffer $R_{base}$= 100Ω for ON & 20Ω for OFF |
| Fall time | $t_f$ | - | 22 | - | | |
| Turn-off delay time | $t_{d(off)}$ | - | 8.1 | - | | |
| Rise time | $t_r$ | - | 10.5 | - | | |

1) Refers to driver GND, see typical operating circuit. Threshold voltage defined as Vth= $V_{DD}$+$V_{th\text{-}GaN}$= 15V+[-9]V=6V
2) In operation Vgs swings from -$V_{DD}$ (OFF state) to 0V (ON state).

| Electrical characteristics ($T_J$ =25°C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typical** | **Max** | **Unit** | **Conditions** |
| **Gate Charge characteristics** | | | | | | |
| Gate to Source charge | $Q_{GS}$ | - | 8 | - | nC | $V_{GS}$=0V to -14V<br>$V_{DS}$=400V $I_D$=32A |
| Gate to Drain charge | $Q_{GD}$ | - | 130 | - | | |
| Total Gate charge | $Q_G$ | - | 200 | - | | |

| Pin Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Typical** | **Max** | **Unit** | **Conditions** |
| **Pin 1, 22 Activation signal** [2] | | | | | | |
| Disable voltage | Pin 1, 22 | 0 | - | 9.1 | V | |
| Enable voltage | Pin 1, 22 | 9.3 | 15 | 15 | | |
| Absolute maximum rating [3] | Pin 1, 22 | -20 | - | 10 | | |
| **Pin 3, 21 Com signal** [3] | | | | | | |
| Voltage at Disable mode | Pin 3, 21 | - | 8 | - | V | VDS >20V |
| Voltage at Enable mode | Pin 3, 21 | 0 | 0 | 0.1 | | |
| **Pin 2, 23 Com Power** [2] | | | | | | |
| | Pin 2, 23 | 10 | 15 | 20 | V | |
| | | | | | | |
| **Pin 5 Enable must be connected to pin 1 or 22** | | | | | | |

1) After applying Activation signal
2) Refers to driver GND, see typical operating circuit
3) Refers to Source Pins

## Typical Characteristics at 25C° (unless noted otherwise)

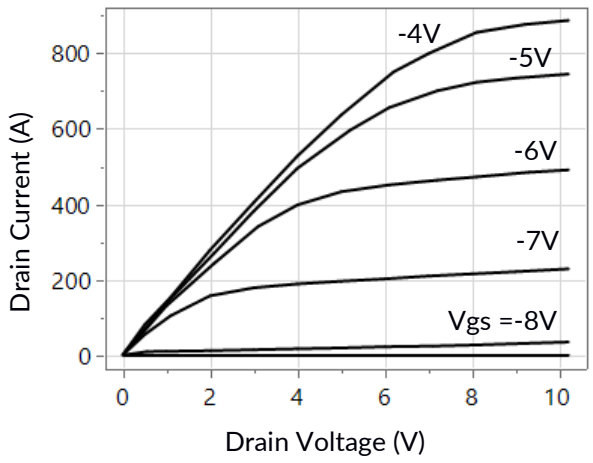



Figure 1 Output (Forward) Characteristics

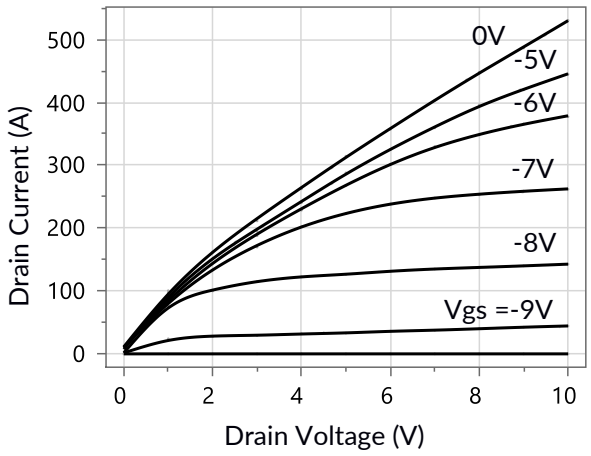



Figure 2 Output (Forward) Characteristics Tj=150C

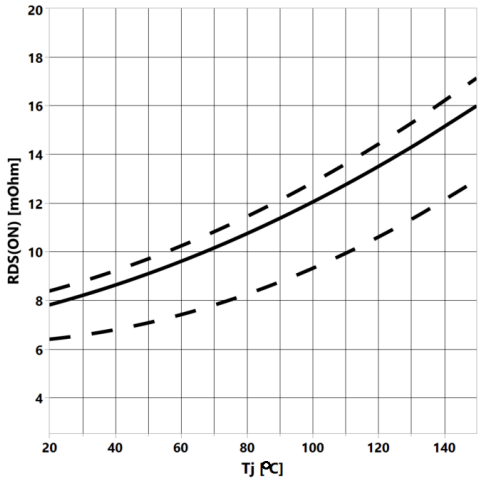



Figure 3 ON-State Resistance vs. Temperature

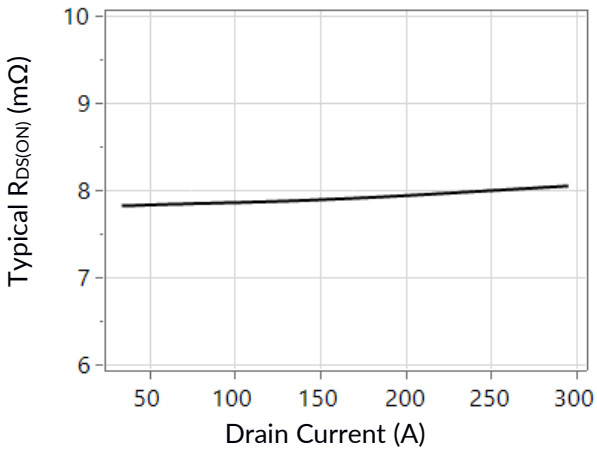



Figure 4 ON-State Resistance vs. Current at 25°C

## Typical Characteristics cont.

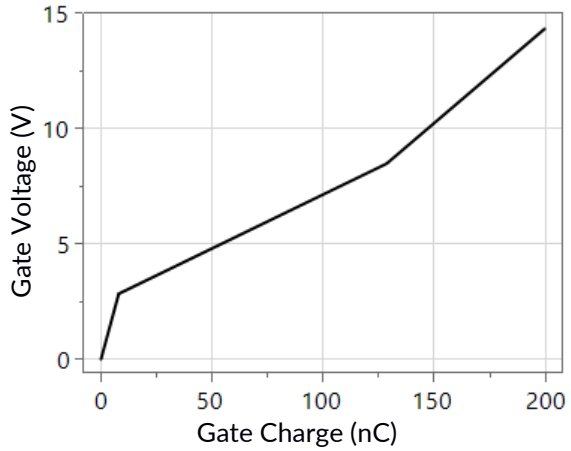



Figure 5 Typical Gate Charge

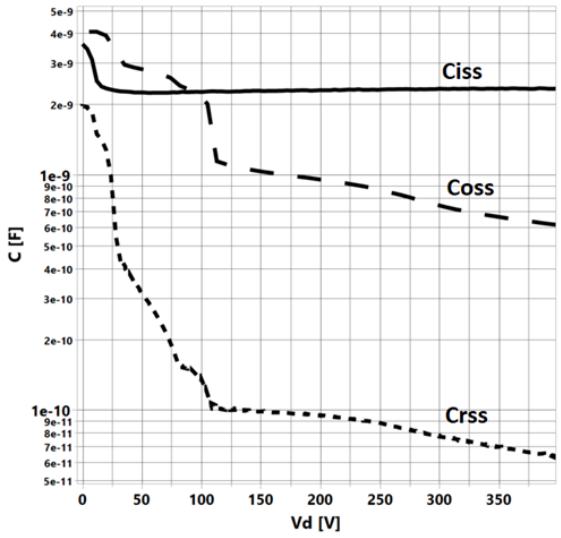



Figure 6 Typical Capacitances

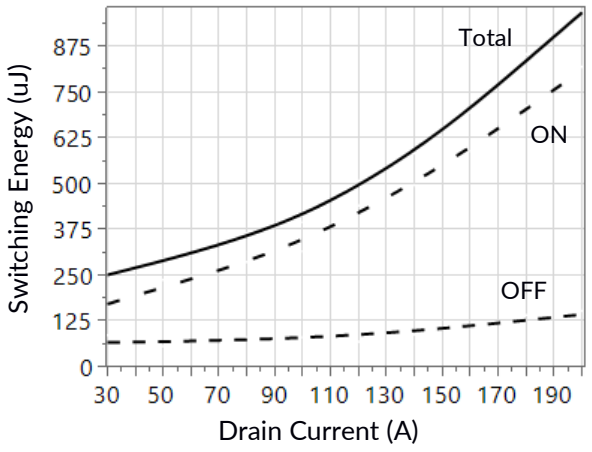



Figure 7 Typical Switching Energy vs Drain Current at 400V

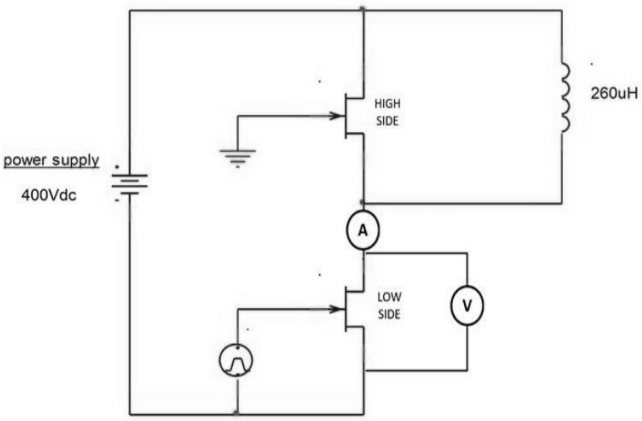



Fig.16: Switching parameters test circuit

## Switching Time Waveforms

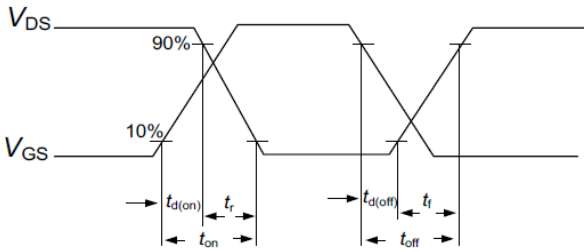
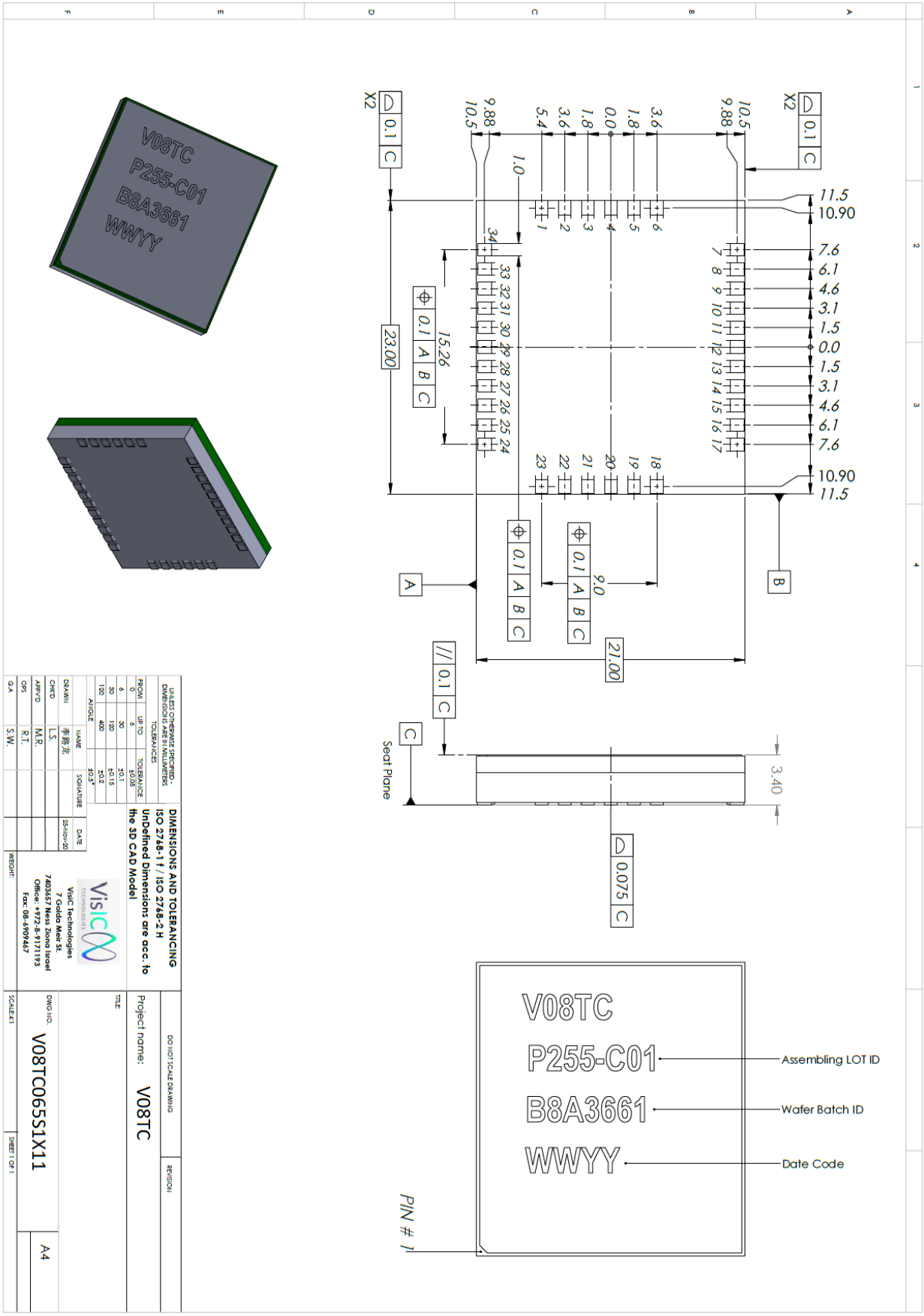



Fig.17: Switching time waveforms

## Package Outlines:



| Rev. | Date | Content of Change | Owner |
|---|---|---|---|
| 1.0 | 31/07/2023 | New datasheet and template under new part number | I.B |
| *1.1* | 22/08/2023 | Changed Rdson value slightly based on updated die measurements, revied Pin characteristics table. | I.B |
| | | | |

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